What a big collection! –

From hunting and gathering user requirements towards implementation

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Motivation

Collections of user requirements for climate services have become common outcomes of many climate service research projects. By now, researchers and users are equally fatigued by the investigation process, and the list of requirements is rarely further expanded with new findings. Instead of continuing to collect user needs, there is the necessity for a synthesis of what has been gathered. The box below represents a starting point by summarizing the most common and well-known user requirements. Building on this foundation, the requirements can be fine-tuned according to individual users. In collaboration, climate service providers and users can design, develop, implement and evaluate effective climate service products. At GERICS, co-development is a central element of creating powerful climate services (see figure at the bottom right).

It is imperative for the climate service community to take the next step: To *transform* the gathered list of requirements into *innovative* service products that *enable* the user to effectively adapt to climate change.

Moving forward by:

- **assessing feasibility of requests, identifying gaps in production/research**
- **implementing services through co-development with each individual user**
- **attending to the user from the very first to the very last step of the co-development and implementation process**
- **evaluating provided services in collaboration with the user**

Approach

The user requirements are collected in seven categories accounting for a typical development process of a climate service. The basis for this analysis is a review of 19 EU research projects and 28 national projects in Europe, as well as personal communication with numerous researchers at GERICS.

The needs listed below give insights and examples of the most commonly mentioned items, but it remains a non-exhaustive list. Further, this list of requirements has not yet been checked for feasibility. It is an unfiltered collection of the users' requirements.

Most commonly named *user requirements* for climate services

1. context & decision-making process

- full adaptation strategies, compare different adaptation alternatives
- classification of threat (intensity, frequency, past vs. future, changes in extremes vs. mean)
- what is most likely (not what might happen?)
- highlight main driver of future vulnerabilities
- center service tool around specific decision-making process instead of a climate related topic
- cost/benefit analyses and comparisons to business as usual
- align climate information to decision-making timescales
- support in the capability to evaluate available climate information and its quality
- ensure continuity of service after the end of a research project

2. available climate data, variables, resolution

- raw variables and climate indices
- sector specific preferences for variables/indices
- main variables of interest: precipitation, temperature, wind, sea level rise, wave height, irradiance, sunshine duration, comfort indices, duration and extent of snow cover
- trends for the next 5-10 years
- extremes (wind, precipitation, temperature, landslide, storm surge, drought, water level of rivers, snow load)
- information on tipping points and their triggers for certain systems
- temporal resolution (hourly – daily)
- spatial resolution (region/local)
- resolution/level of aggregation of non-climate information and climate information has to fit together
- bias adjusted variables

3. opportunities, limitations, uncertainties

- clear explanation of added value of applying climate (change) data
- uncertainty (deterministic vs. probabilistic, reliability scale, confidence index, likelihood, relevance and implication)
- display uncertainties in the form of sensitivity and the interconnection of thresholds and decisions
- infrastructure (free access, fast download, online tool with post-processing options (plotting, combining, comparing, calculating statistics, conversions), standardized archiving, technical limits for user regarding file size and software)
- legal/financial aspects of providing public data for commercial use
- common metadata format (e.g. ESGF standard)

4. data quality

- goal: build trust in data/products
- definition and assurance of state-of-the-art information
- reliability, skill
- data/information provided must come with a "seal of quality"
- validation through observations by provider and by user
- data consistency: same data basis for all analyses/experiments

5. data presentation

- short key messages and concise syntheses
- simple and intuitive visualizations (e.g. maps) including full scientific depth
- visualizations of interplay between multiple climate change stress factors
- non-scientific jargon
- glossary of common vocabulary and statistical definitions
- native language
- guided search in web tools (intuitive GUI)
- possibility to tailor data to specific needs
- possibility to download raw data
- possibility to integrate non-climate information

6. implementation, integration

- flexible decision-making process and flexible climate data/information to ensure effortless integration
- clear benefit of implementation
- visibility
- provide newly produced data promptly

7. evaluation

- there is a gap in assessing the added value and usability of the service after it is finished
- standards for evaluating a climate service are needed
- financing is required for the evaluation after a project is done

Process of transdisciplinary prototype development

Through constant dialogue and interaction, a common language regarding the specific need for adaptation can be established and misunderstandings can be avoided. Requirements can be checked for feasibility, potential gaps in production or research can be identified and tackled. The active exchange between user and climate service provider leads to finding an effectively operating solution which caters to the needs while remaining realistic.

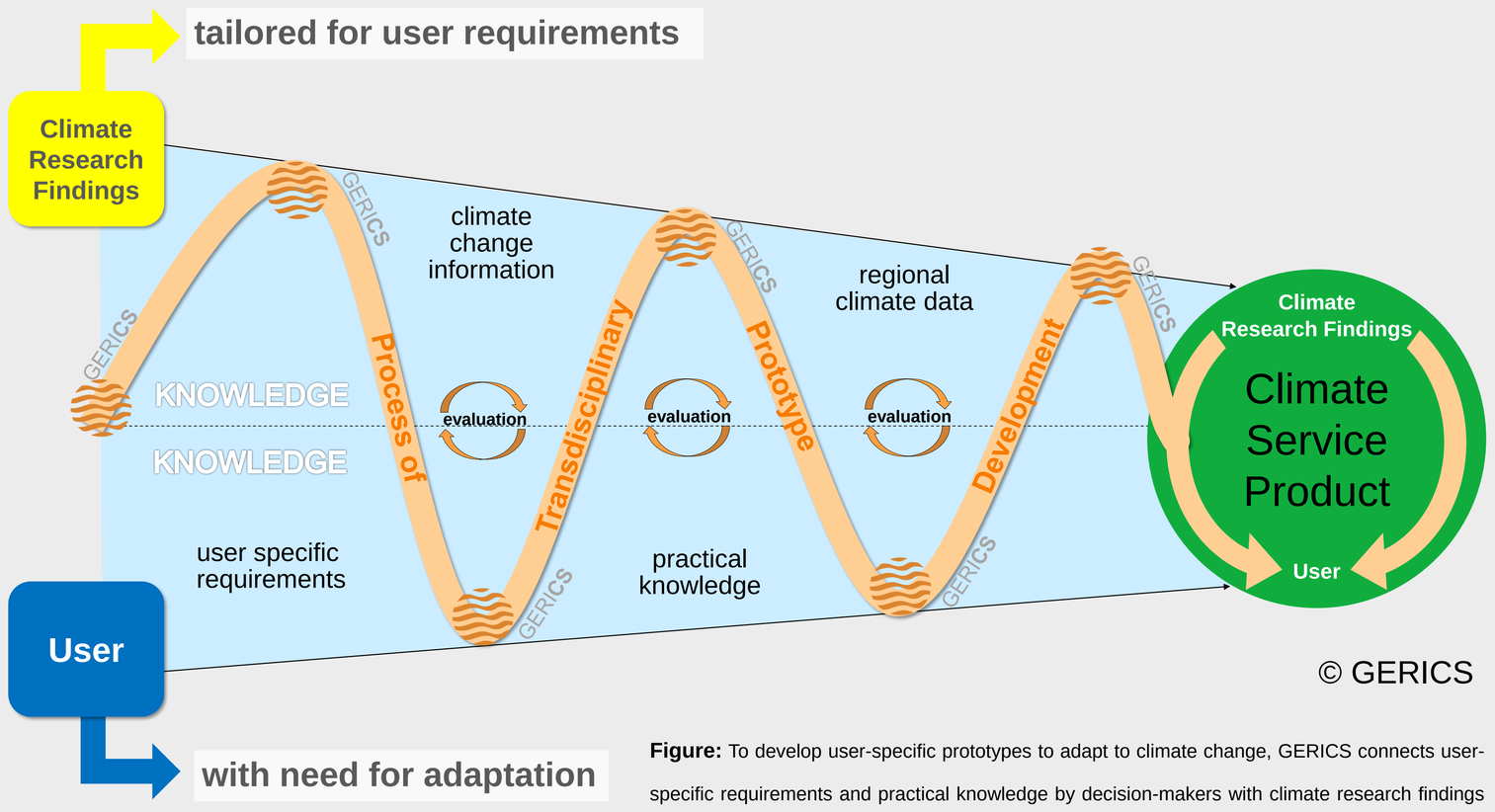

Figure: To develop user-specific prototypes to adapt to climate change, GERICS connects user-specific requirements and practical knowledge by decision-makers with climate research findings applying an iterative, transdisciplinary approach through personal dialogue and networking.

References

- personal communication with GERICS researchers
- FMI, UH, HZG - GERICS, DMI, MetNo, OMSZ, CSC and ABHL (2016) Copernicus Climate Change Service, Project C3S_51 Lot4: "Data Evaluation for Climate Models (DECM)", Deliverables 1.1 and 1.2

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